The Development of Lingnan Hakka "Dun Tou Lan" and Innovative Design of Cooking Technology

Mingliang Li* [1,a], Renrong Shi [2,b]
[a*]e-mail: 1179531419@qq.com; [b]e-mail: 759965839@qq.com

[1] Guangzhou Huashang Vocational College, Zengcheng, Guangzhou, China
[2] Guangzhou Huashang Vocational College, Zengcheng, Guangzhou, China

Abstract. Dun Tou Lan dye is a natural and synthetic polymeric slurry that utilizes viscous action. The traditional cooking process of Dun Tou Lan dyeing and weaving is mostly manual stirring operation and extraction with dacquoise leaf plant dyes, the original manual extraction method greatly reduces the extraction efficiency of the dye. This study added some innovative research, has changed to mechanical automatic stirring to enhance its cooking efficiency, the use of rotary joint stirring design, does not affect the stirring Dun Tou Lan dyeing slurry at the same time, to achieve the rotary feeding of additives, multiple additive injection, innovative stirring shaft and stirring fan blade feeding can make the slurry and additives fully mixed, while stirring additive, to enhance the uniformity of additive feeding, and thus The innovative stirring shaft and stirring fan blade feeding can make the slurry fully mixed with additives, add additives while stirring, improve the uniformity of additives feeding, and thus enhance the mixing speed of additives and slurry, reduce the cooking time and improve product quality.

Keywords: Dun Tou Lan, boiler, innovative boiler

1 Introduction

At present, the “Dun Tou Lan” dyeing and weaving dyestuff is cooked in a manual way, and the quality of the “Dun Tou Lan” is mostly impurities, because the “Dun Tou Lan” is extracted from the plant dyestuff with big green leaves, and the original manual extraction method greatly reduces the efficiency of the dyestuff extraction. The extraction efficiency of dyestuff is greatly reduced, and in the process of dyestuff extraction, impurities are easily added, which affects the quality and speed of dyeing and weaving, and it is impossible to guarantee the same quality of dyestuff cooking each time, which affects the efficiency and quality of “Dun Tou Lan” dyeing and weaving, and reduces the economic efficiency and development of “Dun Tou Lan” . In response to the above problems and challenges, this study aims to optimise the traditional “Dun Tou Lan” dye extraction process, provide innovative and complete machine design solutions to improve the efficiency of “Dun Tou Lan” vegetable dye extraction, save raw materials, improve efficiency and promote the development of innovative “Dun Tou Lan” dyeing and weaving processes.

ADDT 2022, September 16-18, Nanjing, People's Republic of China

DOI 10.4108/eai.16-9-2022.2324870

2 Research significance

Dun Tou Lan" is an intangible heritage in Guangdong Province, China. The villagers use the cotton and hemp in the agricultural production, as well as the big blue, gardenia, cedar and other natural dyeing and weaving materials through several processes such as: spinning, plowing, weaving, dyeing, kicking, and other processes to make it, which is characterized by a fresh style, strong and wearable, and is a valuable heritage left by the ancient ancestors in the Lingnan area of China [1].At present, the Dun Tou Lan dyeing and weaving dyestuff is cooked in the way of artificial quality with impurities, and it is impossible to guarantee the same quality of the dyestuff every time in temperature and year [2].This affects the efficiency and quality of the dyeing and weaving of Dun Tou Lan. The new boiling device introduced in this paper can eliminate the above disadvantages and make the quality of the Dun Tou Lan dye greatly improved.

3 Study Subjects

The traditional printing and dyeing process of "Dun Tou Lan" mainly comes from Pengzhai town of Heping County, which is mostly made of blue color in the dyeing and weaving process, with vivid color and strong contrast, and a unique artistic atmosphere in the plainness, this simple and fresh style of consciousness also contrasts with the strong and open beauty, which is loved by people nowadays[3].

The principle of traditional dyeing of Dun Tou Lan printing and dyeing is to prevent the penetration of dyeing solution through the combination of manual apparatus assistance and fabric folding, modern dyeing and weaving technology is more developed with spray printing, hanging dyeing, 3D printing and other technologies. This makes the traditional handicraft bloom again with splendid vitality [4]. Traditional printing and dyeing methods mostly use tools such as cellulose, such as cotton and hemp products. In the traditional printing and dyeing methods in ancient times commonly used language natural dyes, such as batik most commonly used dyes for indigo dyes, now printing and dyeing processing technology, for cellulose fibers are mostly used in direct dyes. In the period before and after the Ming and Qing dynasties and the liberation, "Dun Tou Lan" is a unique natural blue home machine fabric made by the villagers of dun head village using the locally grown big green leaves as raw materials and using a unique process to make it into dye, and then using the advanced weaving and dyeing techniques at that time. "It is famous for its natural, fresh, simple and harmonious blue color, and the Hakka clothes made of it are simple and generous in style and plain in color, which are sold in the Dongjiang River valley, Eup and neighboring towns in neighboring provinces[5]. The unique textile craft of "Dun Tou Lan" has played an important role in the life of Hakka people. However, there is a bottleneck in the Dun Tou Lan dye extraction, because the Dun Tou Lan is extracted with dacquoise leaf plant dye, the original extraction method by hand greatly reduces the extraction efficiency of the dye, and in the process of dye extraction, it is easy to increase impurities, affecting the quality and speed of dyeing and weaving, reducing the economic benefits and development of Dun Tou Lan.

In response to the above problems and challenges, this study aims to optimize the process of traditional Dun Tou Lan dye extraction, provide innovative and complete machine design solutions, improve the efficiency of Dun Tou Lan plant dye extraction, save raw materials and

improve efficiency as a design framework to promote the development of innovative Dun Tou Lan dyeing and weaving processes. The results of the study will further clarify the development and design of the service process of intelligent industry in the context of industrial connectivity, and provide the necessary architecture and design innovation method reference for the application and development of pierrot blue dyeing and weaving technology. At the same time, it will provide ideas for the design of pierrot blue in interior design soft furnishings, which can also open up new markets for the upstream and downstream companies of the product and can significantly increase the added value of the product. In addition, according to the method proposed in this study, the designed extraction machine from dyeing and weaving can be used for the extraction of Dun Tou Lan dye. The study combines innovative design of the machine with aesthetic study of interior design, thus realizing the value of pierrot blue dyeing and weaving technological innovation services and radiating its surrounding.

The paper is organized as follows Section 1 introduces the current status and research significance of Dun Tou Lan:Section 2 describes the current problems faced by the market of Dun Tou Lan.Section 3 presents the model and design framework of a new Dun Tou Lan dyeing and weaving boiling device for Dun Tou Lan.Section 4 presents the discussion and conclusion respectively.

4 Innovative design study on the extraction process of Dun Tou Lan dye

This project is related to the field of pulp cooking technology, specifically, it is related to the Dun Tou Lan dyeing and weaving pulp cooking device. The project subject group actively explores the pierhead blue dye extraction innovation, hoping to replace the original manual plant dye extraction, the utility model device has been approved to provide pierhead blue dyeing and weaving with cooking slurry device, belongs to the pierhead blue dyeing technology field, the pierhead blue dyeing and weaving with cooking slurry device includes shell assembly and cooking slurry assembly. Said shell assembly includes a cylinder, a head and a top cover, and said cooking slurry assembly includes a heat exchange tube, a hollow shaft, a rotary joint, a feed tube, a hollow fan blade, a driving motor, a slurry inlet and a slurry outlet.

In order to ensure that the slurry can be effectively catalyzed, the cooking volume is to be calculated to determine the liquid level of the slurry in the slurry cooker.

Assuming that the cooking volume V (m3) slurry flow rate Q (m3 /h) slurry cooking time T (h) is consumed by the sizing machine, then

$$V = QT$$

The sizing yarn press-out weighting rate W sizing quality fraction C sizing rate S has the following relationship

$$S = WC$$

Since the sizing rate S slurry mass fraction C are pre-set important process parameters the press-out weighting rate is determined by the sizing rate and slurry mass fraction

$$W = S/C$$

The relationship between the sizing force and the sizing weight obtained can be empirically derived.

The principle of cooking slurry device for Dun Tou Lan dyeing weaving is that when in use, the Dun Tou Lan dyeing slurry is injected into the cylinder through the slurry inlet, the suitable cooking slurry temperature is adjusted through the heat exchange tube, turn on the drive motor, the drive motor drives the hollow fan blade to stir the Dun Tou Lan dyeing slurry, open the feed tube, the additive flows into the fixed end of the rotary joint, the role of the rotary joint is to transport the additive from the fixed feed tube into the rotating hollow shaft, the additive During the mixing process, the slurry will be added not only through the surface hole of the hollow shaft, but also through the surface hole of the hollow fan blade. The design of mixing with the rotary joint does not affect the mixing of the blue-dyed slurry of the pier head while realizing the rotary feeding of the additive, using multiple additive injection, the innovative stirring shaft and stirring fan blade feeding can make the slurry and the additive fully mixed, adding the additive while stirring, enhancing the Uniformity of feeding, thus improving the mixing speed of additives and slurry, reducing cooking time and improving product quality.Temperature dependence of viscosity of complete alcoholysis dye solution(Figure. 1)

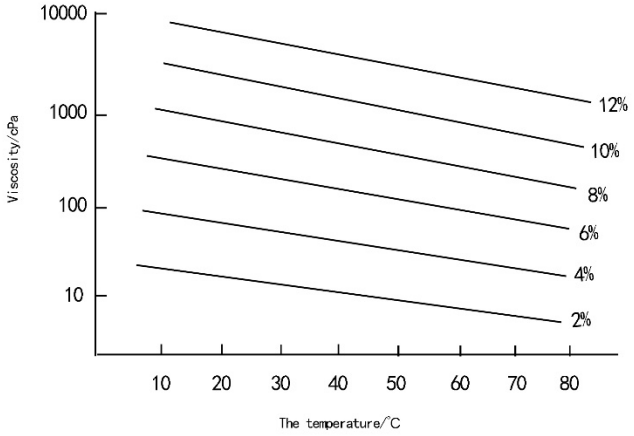

Fig. 1. Temperature dependence of viscosity of complete alcoholysis dye solution

The heat exchanger tube is spirally wound around the circumference of the outer wall of the cylinder, the hollow shaft is rotated vertically inside the cylinder, the fixed end of the rotary joint is lapped at the top center of the top cover, the feed tube is connected to the fixed end of the rotary joint, the bottom of the rotary end of the rotary joint is lapped and fixed at the top end of the hollow shaft, the rotary end of the rotary joint is connected to the hollow shaft, schematic diagram of the three-dimensional structure of the boiling sizing device for pierhead blue dyeing and weaving.(Figure 2).the hollow fan blade is fixed horizontally on the surface of the hollow shaft, the hollow fan blade is connected to the hollow shaft, the body of the drive motor is fixed vertically at the top center of the top cover The drive motor body is fixed vertically at the top center of the top cover, the output end of the drive motor is driven at the top of the rotating end of the rotary joint, the inlet port is set at the top side of the top cover, and the outlet port is set at the bottom center of the said head.

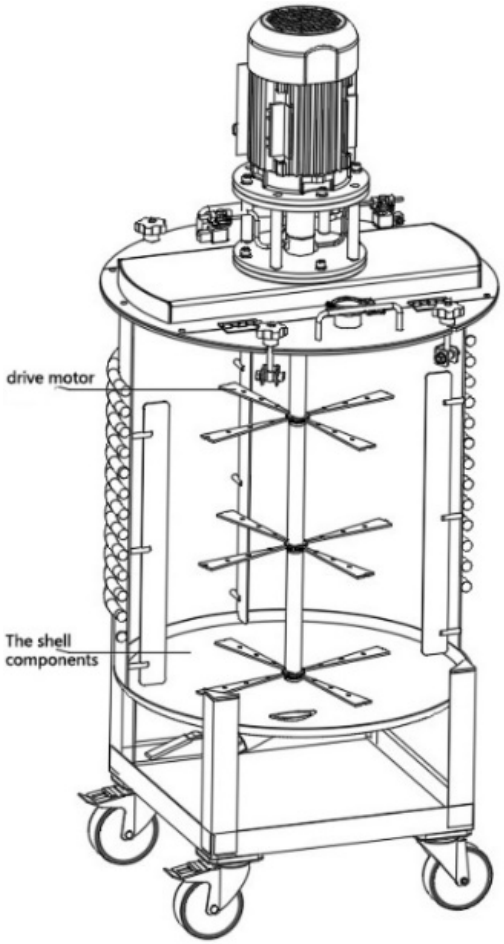

Fig. 2. schematic diagram of the three-dimensional structure of the boiling sizing device for pierhead blue dyeing and weaving.

The cooker should keep the sequence of raw pulp beaten in as long as possible, otherwise the pulp may be undercooked (raw pulp sinks to the bottom) or overcooked (cooked pulp turns up). To this end, several points should be noted.

(1) Use a wrench or round bar stirrer instead of a bladed stirrer to reduce the tumbling and mixing of the upper and lower layers of slurry. In the slurry cooker on the long shaft at regular intervals installed a stirrer. The long shaft is divided into two sections of the upper and lower drive respectively. For cooking pulp volume of small varieties can only open the following section.

(2) steam pipe nozzle towards the horizontal direction along the length of the steam pipe in the direction of several sections of steam supply to the liquid surface above the part not open steam. When cooking starch slurry in the factory is generally used to cook half an hour and bored half

an hour. In the continuous slurry cooker can be separated from the upper half of the large steam boiling the lower half of the small steam smothered slurry.

(3) cooking slurry before calculating the cooking volume to determine the position of the liquid surface raw slurry imports with a hose hose marked with a scale so that the raw slurry imports and liquid level is equal to the end of the hose raw slurry imports are also horizontal.

(4) boil slurry diameter should be small raw slurry time series to maintain the change, but taking into account the height of the plant boil slurry height should not exceed 5m.

(5) due to the height of the cooking slurry device is larger for cooking slurry volume of small varieties, as long as the liquid level to maintain a low can ensure cooked slurry, cooking slurry device should have a suitable liquid level observation window to facilitate the operation of the slurry tuner observation. Schematic diagram of the three-dimensional structure of the housing assembly (Figure 3). As the liquid level should be controlled cooking slurry device every certain distance installed a sensor according to the detection requirements to choose to use two of the adjacent sensors.

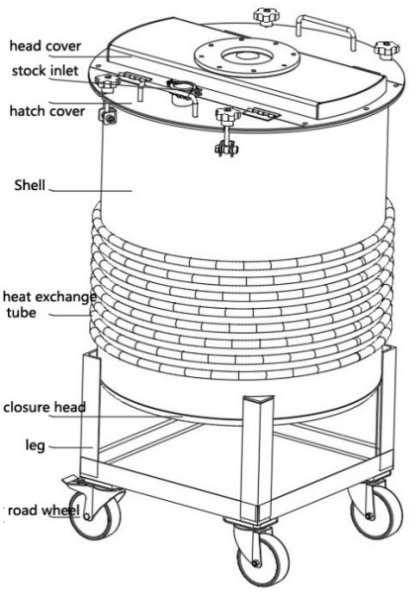

Fig. 3. Schematic diagram of the three-dimensional structure of the housing assembly.

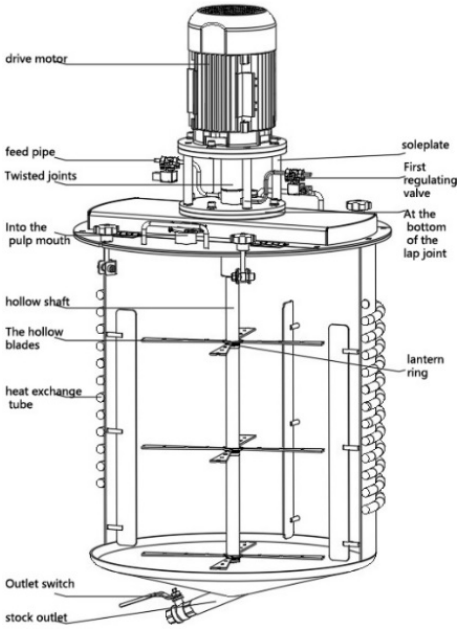

Fig. 4. schematic diagram of the three-dimensional structure of the cooking slurry assembly

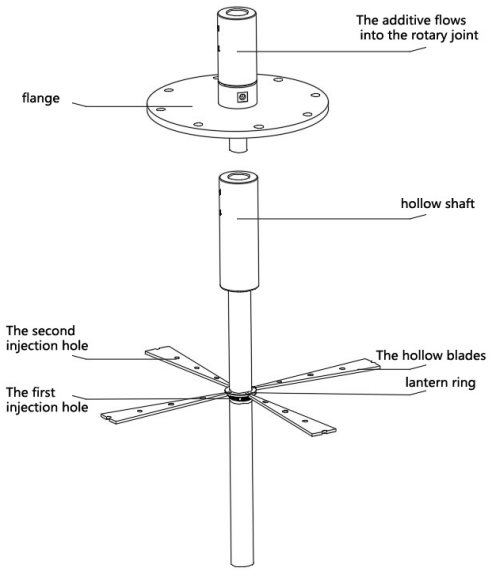

Fig. 5. Schematic diagram of the partial enlarged three-dimensional structure of the cooking slurry assembly.

There are legs on the circumference of the bottom of the cylinder. There are walking wheels at the bottom of the legs.There is a hatch cover on both sides of the top of the top cover, and one side of said hatch cover is rotated on the top side of said top cover, and the slurry inlet is set on the upper surface side of said hatch cover. The surface of the hollow shaft is fixedly connected with a sleeve ring, the hollow fan blade is fixedly connected to the sleeve ring (surface, the surface of the sleeve ring is opened with the first liquid injection hole, the first liquid injection hole is connected to the said hollow shaft and the barrel body respectively. The fixed end of the rotary joint of the pierhead blue dyeing and weaving device is fixed with a flange at the bottom, and the bottom of the flange is lapped at the top center of the top cover. There is a first regulating valve on one side of the feeding pipe of the pierhead blue dyeing and weaving device, and the first regulating valve is connected to the fixed end of the rotary joint and the external additive supply line respectively. There is a second liquid injection hole on the surface of the hollow fan blade of the pierhead blue dyeing and weaving device, and the second liquid injection hole is connected to the said hollow shaft and the said cylinder respectively. There is a mounting base at the bottom of the driving motor of the pierhead blue dyeing and weaving device, and the bottom of said mounting base is fixed to the top side of said flange. A second regulating valve is provided outside the slurry outlet of the Dun Tou Lan dyeing and weaving boiling device, and the second regulating valve is connected to said barrel and external slurry line respectively.

The cooking slurry device includes housing assembly and cooking slurry assembly, and the cooking slurry assembly is installed in the housing assembly, and the cooking slurry assembly adds additives while stirring. schematic diagram of the three-dimensional structure of the cooking slurry assembly(Figure 4).The housing assembly includes a barrel, a head and a top cover, the top of the head is set horizontally at the bottom of the barrel, the head is welded to the barrel, the bottom of the top cover is lapped horizontally at the top of the barrel, the top cover is welded to the barrel 1, there are legs on the circumference of the bottom of the barrel, it is convenient to leave the working area of the slurry outlet, it is convenient to walk the pipe, there are walking wheels on the bottom of the legs, it is convenient to move the device, there are hatches on both sides of the top of the top cover symmetrically, one side of the hatch is rotated The hatch cover is set on the top side of the top cover, and the slurry inlet is set on the top surface side of the hatch cover. The pre-set hatch cover is convenient for the staff to observe the slurry cooking condition, and it is convenient for the installation of the mixing parts and the cleaning of the cylinder body. The cooking slurry assembly includes heat exchanger tube, hollow shaft, rotary joint, feed tube, hollow fan, drive motor, inlet and outlet, the heat exchanger tube is spirally wound around the outer wall of the barrel, and the cooking slurry is heated and kept warm by the heat exchanger tube, there is a bearing in the bottom center of the top cover, the upper end of the hollow shaft is rotated in the bearing, the hollow shaft is rotated vertically in the barrel, the fixed end of the rotary joint is connected with a flange at the bottom, and the bottom of the flange is lapped at the top center of the top cover, and the flange is connected with the barrel. In this embodiment, there is a cavity in the center of the rotating end of the rotary joint to facilitate the connection with the hollow shaft, the top and bottom of the rotating end of the rotary joint protrude from the fixed end, which can be connected with the drive motor through the top of the rotating end of the rotary joint, Schematic diagram of the partial enlarged three-dimensional structure of the cooking slurry as-sembly (Figure 5).the bottom of the rotating end of the rotary joint is connected with the hollow shaft to facilitate the transmission between the output end of the drive motor and the top end of the hollow shaft, the rotating end of

the rotary joint is connected with the hollow shaft, and the drive motor is connected with the top end of the hollow shaft. The bottom of the rotating joint is connected to the hollow shaft, and the bottom of the rotating joint is connected to the hollow shaft, and the bottom of the rotating joint is connected to the hollow shaft. Wherein, the feed tube is connected to the fixed end of the rotary joint, the feed tube provides additives, the first regulating valve is provided on one side of the feed tube, the first regulating valve is connected to the fixed end of the rotary joint and the external additive supply line respectively, the first regulating valve controls the feed of additives, the surface of the hollow shaft is fixedly connected to the sleeve ring, the hollow fan blade is fixedly connected to the surface of said sleeve ring, the surface of the sleeve ring is opened with the first liquid injection hole, the first liquid injection hole is connected to the hollow shaft and the barrel shaft respectively. The hollow fan blade is fixed on the surface of the hollow shaft, the surface of the hollow fan blade is evenly distributed with the second liquid injection hole, the second liquid injection hole is connected to the hollow shaft and the cylinder, the hollow fan blade is connected to the hollow shaft, the hollow fan blade will inject the additive into the blade through the second liquid injection hole on the surface during the mixing of the hollow fan blade, which can make the slurry and the additive The bottom of the drive motor is provided with a mount, the bottom of the mount is fixed to the top side of the flange, the body of the drive motor is fixed vertically above the top center of the top cover, the mount is screwed to the drive motor and the flange respectively. The output of the drive motor is driven to the top of the rotating end of the rotary joint, and the rotary joint design is used so that the stirring does not affect the flow of additives into the hollow shaft at the same time.

The specific working principle of the Dun Tou Lan dyeing and weaving cooking slurry device: when used, the Dun Tou Lan dyeing slurry is injected into the barrel through the slurry inlet, and the suitable cooking temperature is adjusted through the heat exchange tube, turn on the drive motor, the drive motor drives the hollow fan blade to stir the Dun Tou Lan dyeing slurry, open the feed tube, the additive flows into the fixed end of the rotary joint, the role of the rotary joint is to transport the additive from the fixed feed tube to the rotating hollow In the process of stirring, the additive will not only be added to the slurry through the first liquid injection hole on the surface of the hollow shaft, but also through the second liquid injection hole on the surface of the hollow fan blade, the rotary joint will drive while the input of additive is carried out, realizing the additive discharge of the rotating stirring shaft stirring fan blade, adding additive while stirring, the pier head blue dyeing slurry is stirred more fully, the additive and slurry are mixed better, and the product quality is higher. The product quality is higher.

5 Conclusions

The design solution adopts the rotary joint mixing design, which allows the additives to rotate through the equipment for feeding without affecting the mixing of the dye slurry, and adopts multiple additive injection, and the innovative stirring shaft and stirring fan blade feeding can make the slurry fully mixed with the additives, and add additives while stirring, which improves the uniformity of the additive feeding and effectively improves the quality of the extracted dyes, which in turn improves the mixing speed of the additives and slurry, reduces the cooking time, and improves the efficiency and quality of the product production. The mixing speed of the additive and the pulp, reduce the cooking time, and improve the production efficiency and quality of the product.

In order to improve the quality of Dun Tou Lan dyestuff extraction and cooking pulp, people keep increasing the investment in the production scale and increasing the manual extraction of dyestuff, but the main process of cooking pulp does not play enough attention to the Dun Tou Lan cooking pulp device has successfully applied for a utility model patent and is being prepared for production, it can avoid the drawbacks of manual extraction of dacquoise leaf dyestuff, and its application prospects are optimistic.

Acknowledgments

The work described in this article is fully supported by the 2020 Guangdong Provincial General Colleges and Universities Young Innovative Talent Project (No. 2020WQNCX248)

References

[1] Wu Yuanxin, Wu Lingmei Chinese Folk Culture Research "Folk Culture - Blue Print Fabric" 2007

[2] Zhong Maoran folk dyeing and weaving art China Textile Publishing House, 2002

[3] Wu Yuanxin Chinese blue printed fabric pattern book pattern volume Shanghai People's Publishing House, 2005

[4] Zhang Ju Ping Hubei Tianmen Blue Printed Fabric in Decoration, 2006, No.1

[5] Bao Xiaolong, Liu Yuexin "hand printing and dyeing art" Shanghai: Donghua University Press, 2013.4